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## Türk Fizyoterapi ve Rehabilitasyon Dergisi

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Fatih SÖKE, PT<sup>1</sup>  
 Hayriye KUL KARAALİ, PhD, PT<sup>1</sup>  
 Duygu ILGIN, PhD, PT<sup>1</sup>  
 Ertuğrul YÜKSEL, MS, PT<sup>2</sup>  
 Özlem ÖZCAN, MS, PT<sup>1</sup>  
 Tuğba ARSLAN, MS, PT<sup>3</sup>

- 1 Manisa Celal Bayar University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Manisa, Turkey.
- 2 Dokuz Eylül University, Health Sciences Institute, İzmir, Turkey.
- 3 Pamukkale University, Health Sciences Institute, Denizli.

### İletişim (Correspondence):

Hayriye KUL KARAALİ, PhD, PT  
 Manisa Celal Bayar University,  
 Faculty of Health Sciences, Department of  
 Physiotherapy and Rehabilitation, Uncubozkoy,  
 45030 Manisa, Turkey.  
 Phone: +90-236-233 0904 ext. 5881  
 Fax: +90-236-233 7169  
 E-mail: hayriye.karaali@cbu.edu.tr

Fatih SÖKE - E-mail: fthsk\_8993@hotmail.com  
 Duygu ILGIN / E-mail: duygu.ilgin@cbu.edu.tr  
 Ertuğrul YÜKSEL / E-mail: er-tugrl@hotmail.com  
 Özlem ÖZCAN / E-mail: ozlem.ozcan@cbu.edu.tr  
 Tuğba ARSLAN / E-mail: tubapksr@gmail.com

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## RELATIONSHIP BETWEEN POSTURAL CONTROL AND HAND FUNCTION IN THE SUBJECTS AGED 65 YEARS AND OVER

### ORIGINAL ARTICLE

#### ABSTRACT

**Purpose:** This study was aimed to investigate the relationship between postural control and hand function in the elderly.

**Methods:** One hundred-five elderly individuals that are 65 years old or over and living in a nursing home were included in the study. Postural control status (Berg Balance Scale) and hand function (manual dexterity: Nine Hole Peg Test, hand grip strength: handheld dynamometer, pinch grip strength: pinchmeter) of elderly individuals were evaluated.

**Results:** The mean age of the subjects was 76.59±6.92 years, and there were 25 females (23.8%) and 80 males (76.2%). There was a statistically significant correlation between postural control and manual dexterity (dominant hand:  $r=0.857$ ,  $p=0.001$  and non-dominant hand:  $r=0.794$ ,  $p=0.001$ ). A statistically significant correlation between postural control and hand grip strength (dominant hand:  $r=0.430$ ,  $p=0.001$  and non-dominant hand:  $r=0.423$ ,  $p=0.001$ ), and a statistically significant relationship was found between postural control and pinch grip strength (dominant hand:  $r=0.390$ ,  $p=0.001$  and non-dominant hand:  $r=0.305$ ,  $p=0.002$ ).

**Conclusion:** Our study showed that there was a significant relationship between postural control and hand function. This suggests that postural control-enhancing exercise programs might be useful. Therefore, we thought that further study is needed to investigate the effects of postural control to protect and improve the hand function for the elderly enhancing exercise programs for the elderly on the hand function to clarify the issue.

**Key Words:** Aged; Hand Function; Postural Equilibrium.

## 65 YAŞ ÜSTÜ BİREYLERDE POSTÜRAL KONTROL VE EL FONKSİYONU ARASINDAKİ İLİŞKİ

### ARAŞTIRMA MAKALESİ

#### ÖZ

**Amaç:** Bu araştırmanın amacı yaşlılarda duruş dengesi ve el fonksiyonu arasındaki ilişkinin incelenmesiydi.

**Yöntem:** Huzurevinde yaşayan 65 yaş ve üstü 105 yaşlı birey araştırmaya dahil edildi. Yaşlı bireylerin duruş dengesi durumu (Berg Denge Ölçeği) ve el fonksiyonu (el becerisi; Dokuz Delikli Peg Test, el kavrama kuvveti; el dinamometresi, parmak kavrama kuvveti; pinchmetre) değerlendirildi.

**Sonuçlar:** Olguların yaş ortalaması 76,59±6,92 yıl ve 25'i kadın (% 23,8), 80'i erkek (% 76,2) idi. Duruş dengesi ve el becerisi arasında (dominant el  $r=0,857$ ,  $p=0,001$  ve non-dominant el  $r=0,794$ ,  $p=0,001$ ), anlamlı ilişki olduğu belirlendi. Kavrama kuvveti ve postural kontrol (dominant el  $r=0,430$ ,  $p=0,001$  ve non-dominant el;  $r=0,423$ ,  $p=0,001$ ). Parmak kavrama kuvveti ve postural kontrol arasında ise (dominant el  $r=0,390$ ,  $p=0,001$  ve non-dominant el ( $r=0,305$ ,  $p=0,002$ ) istatistiksel olarak anlamlı bir korelasyon olduğu saptandı.

**Tartışma:** Araştırmamız postüral kontrol ile el fonksiyonları arasında anlamlı bir ilişki olduğunu gösterdi. Bu durum yaşlı bireylerin el fonksiyonlarını koruma ve geliştirme için postüral kontrolü artırıcı egzersiz programlarının faydalı olabileceğini akla getirmektedir. Bu nedenle ileriki çalışmalarda, yaşlı bireylere uygulanacak postüral kontrolü artırıcı egzersiz programlarının el fonksiyonları üzerine etkilerinin incelenmesinin konuya açıklık getireceği düşünülmektedir.

**Anahtar Kelimeler:** Yaşlı; El Fonksiyonu; Duruş Dengesi.

## INTRODUCTION

Aging, because of its adverse effects on the motor function, is a physiological process that affects the daily life activities of the subjects (1,2). The hand function play a crucial role. For this reason, the prevention while the daily life activities are carried on, of hand function and the presentation of the factors that have adverse effects over the hand function are the critical subjects of the geriatric rehabilitation (3). One of the factors affecting hand function is postural control and that the upper extremity function such as reaching objects, gripping and changing positions require a stable trunk (4).

With the increasing age, functional losses were seen in seeing, vestibular system, proprioception, reaction time and musculoskeletal system lead to an impairment in postural control (5). Previous studies have focused on healthy children and adults, and containing limited data about older adults under the risk of impairment of the hand function (6-9). The examination of whether there is a relationship between postural control and hand function in elderly individuals may help determine the cause of hand function impairment. For this reason, our study aimed to investigate the relationship between postural control and hand function in the elderly. We hypothesized that whether there was a correlation between hand function and postural control in the elderly.

## METHODS

This study was a cross-sectional study which was conducted to examine the relationship between postural control and hand function in the elderly between January 2015 and July 2015. This study was carried out in Manisa City in a nursing home with special status attached to Manisa Nursing Foundation in Manisa Province and nursing homes connected to the Provincial Directorate of Family and Social Policies in the provincial center and districts. Among the 256 individuals living in nursing homes, 105 individuals who were present in the nursing home at the day of the assessment was performed and also who met the criteria for inclusion were included in the study with their written informed consent.

Inclusion criteria were having an age of 65 years or

above, not having any fracture history of the hand, wrist, or finger joints in the last year, the absence of any orthopedic problem that would affect postural control, not having any problem that can affect gripping by hand, not having any disease leading to neurological disability (cerebrovascular disorders, Parkinson's disease, multiple sclerosis, vertigo), not having or using any device that helps hand-function or walking, and having a Mini-mental state examination score of  $\geq 22$  for the educated subjects and  $\geq 18$  for the non-educated subjects (10).

Our study was approved by the Institutional Ethics Review Board of Celal Bayar University Medical Faculty of Medicine, Local Ethics Committee (Date: 03/12/2014, Number: 20478486-395).

## Procedures

Before starting the study, patients were informed, and their written consent for the study was taken. The mental state of the patients was determined by using Mini-Mental Status Assessment Questionnaire of which Turkish validity and reliability study was conducted in the educated and uneducated elderly. The demographic information (gender, age, height, weight, body mass index) and dominant hand information of the patients who scored the Mini-Mental Status Assessment Questionnaire sufficiently were noted by question and answer method face to face. Nine Hole Peg Test (NHPT) was repeated two times without a break for either hand. Hand grip strength was measured. Pinch grip strength measurements were performed. A one minute pause was given between the strength measurements and the peg test. Finally, the balance of the patients was evaluated using Berg Balance Scale (BBS) (11).

## Postural Control

To evaluate the postural control, BBS was used. 14-item scale designed to measure balance for the elderly. It is a five-point scale, ranging from 0-4. "0" indicates the lowest level of function and "4" indicates the highest level of function (11).

## Hand Function

### Manuel Dexterity

The NHPT was used. Test instructions were as follows for the subjects: "On this test; I want you to

**Table 1:** Characteristics of the Subjects.

Characteristics	Subjects (n=105)	
	Mean $\pm$ SD	min-max
Age (years)	76.59 $\pm$ 6.92	65.0-90.0
Weight (kg)	70.55 $\pm$ 11.01	47.0-105.0
Height (cm)	166.42 $\pm$ 7.97	150.0-186.0
BMI (kg/m <sup>2</sup> )	25.51 $\pm$ 3.83	17.96-35.56

BMI: Body Mass Index.

pick up the pegs one at a time, using one hand only, and put them into the holes as quickly as you can in any order until all the holes are filled. Then, without pausing, remove the pegs one at a time and return them to the container as quickly as you can". The test was started when the individual touched the first wooden peg and was terminated when the last wooden peg was put back to the container. Test time was measured by using a chronometer and recorded as test score in seconds. The test was repeated twice for each hand. The mean value was recorded (12).

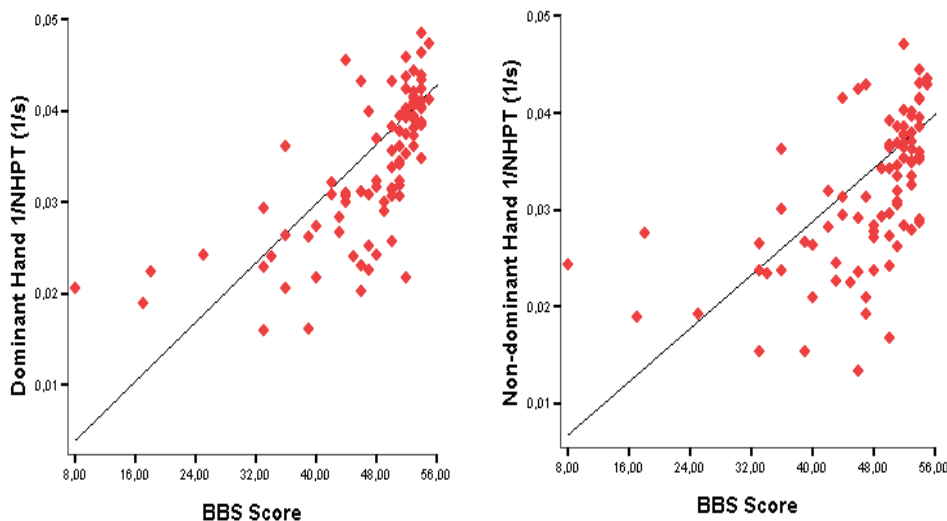
### Hand and Pinch Strength

Jamar hand-held dynamometer (Fabrication Enterprises, Inc., White Plains, New York, USA) measured hand grip strength. The subjects were comfortably seated in a chair without armrests, with feet entirely resting on the floor, hips as far back in the

chair as possible, and the hips and knees positioned at approximately 90 degrees. The shoulder of the tested extremity was adducted and neutrally rotated, the elbow flexed at 90 degrees, the forearm in the neutral position. Subjects were instructed to maintain their position during the test. Jamar Pinchmeter (Fabrication Enterprises, Inc., White Plains, New York, USA) measured pinch grip strength. Lateral grip strength which formed by the thumb and index finger was measured. Measurements were repeated three times, and the average value for both hands was recorded. One-minute rest was given after each measurement (13,14).

### Statistical Analysis

Statistical analysis was performed with SPSS 15.0 software package (SPSS Inc., Chicago, IL, USA). Descriptive data are presented as mean $\pm$ SD. Kolmogorov-Smirnov test was used to analyze the appro-



**Figure 1:** The Relationship between Berg Balance Test (BBS) and Dominant and Nondominant Nine Hole Peg Test Time (NHPT) Results.

**Table 2:** The Results of Balance Test and Hand Function Tests.

Variables	Subjects (n=105)	
	Mean $\pm$ SD	min-max
BBS Score (0-56)	48.46 $\pm$ 8.72	8.0-56.0
	Dominant Hand	Non-dominant Hand <sup>φ</sup>
NHPT Time (second)	29.54 $\pm$ 9.35	31.54 $\pm$ 10.58
Hand Grip Strength (kg)	25.39 $\pm$ 9.69	24.29 $\pm$ 9.64
Pinch Grip Strength (kg)	6.13 $\pm$ 2.12	5.65 $\pm$ 1.86

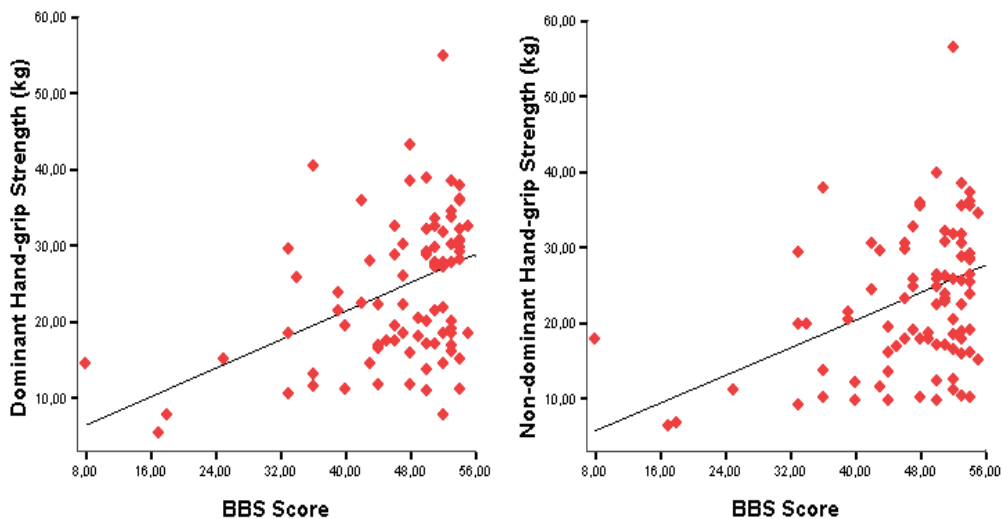
<sup>φ</sup>Mean  $\pm$ SD. BBS: Berg Balance Scale Score, NHPT: Nine Hole Peg Test Time.

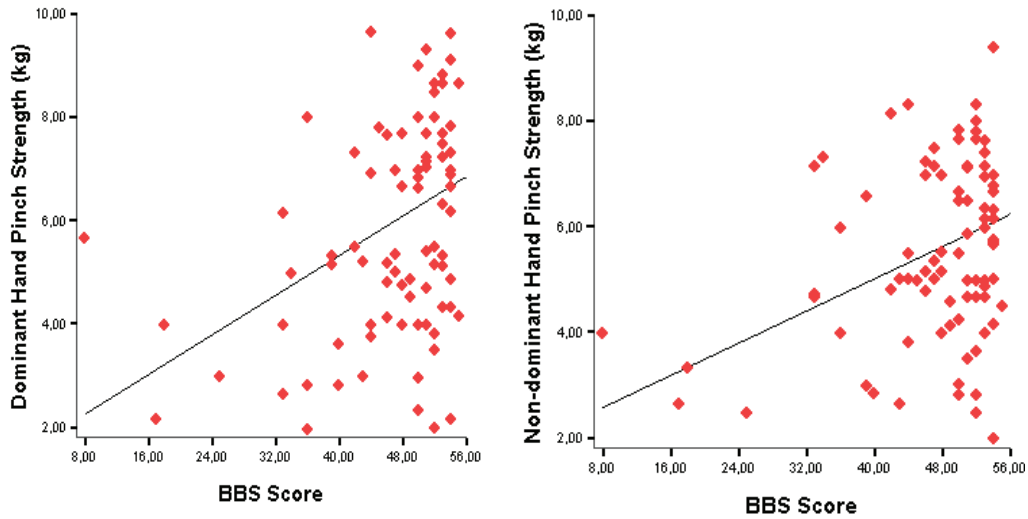
priateness of the numerical results to the normal distribution. In the analysis of the normally distributed data analysis, Pearson correlation analysis, and in the analysis of the data that does not conform to the normal distribution, Spearman's correlation analysis was used. The power of the correlation were categorized as follows: weak ( $r=0.20-0.39$ ), moderate ( $r=0.40-0.59$ ), strong ( $r=0.60-0.79$ ), and very strong ( $r=0.80-1.00$ ). The  $p<0.05$  was accepted as statistically significance level (15).

## RESULTS

The mean age of the subjects participated to the study was  $76.59\pm6.92$  years ( $n=25$ , 23.8% female;  $n=80$ , 76.2% male). Of the subjects, 100 were right-handed, and five were left-handed. The demographic characteristics of the subjects were shown in Table 1.

Test scores related to the subjects' balance-test and dominant and non-dominant hand function tests are shown in Table 2. There was a statistically significant very strong positive correlation between postural control and NHPT results (dominant hand:  $r=0.857$ ,  $p=0.001$  and non-dominant hand:  $r=0.794$ ,  $p=0.001$ ) (Figure 1). A statistically significant moderately strong positive correlation was found between postural control and hand grip strength (dominant hand:  $r=0.430$ ,  $p=0.001$  and non-dominant hand:  $r=0.423$ ,  $p=0.001$ ) (Figure 2). A statistically significant weak positive correlation between postural control and pinch grip strength (dominant hand:  $r=0.390$ ,  $p=0.001$  and non-dominant hand:  $r=0.305$ ,  $p=0.002$ ) was found (Figure 3).

**Figure 2:** The Relationship between Berg Balance Scale (BBS) Score and Dominant and Nondominant and Grip Strength Test Results.



**Figure 3:** The Relationship between Berg Balance Scale (BBS) Score and Dominant and Nondominant Pinch Grip Strength Test Results.

## DISCUSSION

The main results demonstrated that there was a significant relationship between postural control and hand function, and the most powerful connection was between postural control and manual dexterity.

In the literature, the studies investigating the relationship between postural control and hand function, focused on children and adults are presented, while the data related to elderly are quite limited. Hodges and Gandevia conducted a study on five adults aged between 25-44 years and investigated the electromyography activity of the trunk muscles' which are responsible for postural stability during upper extremity movements. They determined an increase in shoulder flexion, elbow flexion, wrist extension, and finger extension and thumb abduction movements in erector spine, diaphragm and transverses abdominis muscles' electromyography activities (16). Miyake et al. used Purdue pegboard test to assess upper extremity motor skills and a stabilometer to assess the postural stability of 40 healthy students from the study and control groups. After applying an exercise program, they reported an increased postural stability and upper extremity motor skills in the study group. In the same study, authors applied the same exercise program to a case with cerebellar ataxia. They observed manipulating skills and time in using a calculator and in cutting paper with scissors. They found significant

improvements in measured parameters. The authors concluded that an increase in postural stability would improve the upper extremity function (17). Ellis et al. investigated physical function and motor impairments as determinants of quality of life in patients with Parkinson' disease, using BBS and NHPT, and found that those two test scores had a significant relationship between them (18). Fujita et al. measured trunk muscles responsible from the postural stability, in stroke patients with and without weak trunk muscles patient without weak trunk muscles were more dependent in the daily life activities requiring upper extremity function such as dressing, using the toilet, transfer activities. Moreover, they reported that those patients could get benefit from the exercises aimed to develop trunk stability (19).

In our study, postural control and hand function have been investigated in subjects 65 years and over, without any neurological problem, as compared with the previous studies. Similar results were obtained. Based on the very strong relationship between the postural control and hand function, one of the reasons for the impairments of the hand function in the elderly could be insufficiencies in the postural control. Exercise programs aiming to increase postural control could be helpful in protecting and improving hand function for the elderly.

Another result of the study was that there is a significant relationship between postural control and



hand grip and pinch grip strength. The literature for the elderly without any disability showed limited number of studies. Stevens et al. in their study with 349 men and 280 women aged between 63-73 years, found that only for men there was a strong relationship between body balance assessed using Flamingo Balance Test and hand grip strength (20). In our study, the gender was not taken into account for the relationship between the postural control and hand grip strength since our study group had only 25 women (23.8%). This factor should be considered for the future studies. In another study investigating the relationship between body balance and hand grip strength Jenkins et al. have not found any link between body balance assessed using functional reach test and handgrip strength in their study carried out by 16 senior men (21).

In our study, the reason for obtaining a different result from the abovementioned study, could be the use of a scale which evaluates postural control in a more than one activity.

The most critical methodological limitation of our study that trunk force, and lower limb muscle strength and fatigue that could affect the posture balance have not been assessed.

As a result, showed that there is a significant relationship between postural control and hand function. This suggests that to protect and/or improve the hand function for the elderly, postural control-enhancing exercise programs might be useful. Therefore, in future studies, researching the effects of postural control-enhancing exercise programs for the elderly on the hand function would clarify the issue.

**Sources of Support:** No external funding was secured for this study.

**Conflict of Interest:** The authors have no conflicts of interest to disclose.

**Ethical Approval:** Our study was approved by the Institutional Ethics Review Board of Celal Bayar University Medical Faculty, Local Ethics Committee (Date: 03/12/2014, Number: 20478486-395).

**Informed Consent:** A written informed consent was obtained from each subjects.

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